CLAIMS

What is claimed is:

1. A method of improving the interface between a dielectric and a semiconductor material comprising the steps of:

preparing a passivated semiconductor surface using a valance-mending agent;

depositing a precursor to a dielectric on the valence-mended semiconductor surface; and

oxidizing the precursor to a dielectric, wherein depositing and oxidizing do not damage the valence-mended semiconductor surface.

2. The method of claim 1, wherein the precursor to a dielectric is a metal selected from the group of metals whose oxide is a dielectric.

3. The method of claim 1, wherein oxidizing is in an oxygen-containing ambient.

4. The method of claim 1, wherein the oxygen-containing ambient is selected from the group consisting of pure oxygen, an oxygen and hydrogen mixture, water vapor, an oxygen and nitrogen mixture, nitric oxide, nitrous oxide, ozone and combinations thereof.

5. The method of claim 1, wherein the semiconductor surface is selected from the group consisting of silicon, germanium, silicon-germanium and silicon-carbide.

6. The method of claim 1, wherein depositing is by evaporation selected from the group consisting of thermal evaporation and electron-beam evaporation.

7. The method of claim 1, wherein oxidizing is from a few seconds to a few hours.

8. The method of claim 1, wherein oxidizing uses a pressure from a few milli-Torr to atmospheric pressure.

9. The method of claim 1, wherein the passivating agent is selected from the group consisting of Group V, VI, or VII congener, or hydrogen.

10. The method of claim 1, wherein the valence-mended semiconductor surface is one atomic layer thick.

11. The method of claim 1, wherein during oxidizing the valence-mended semiconductor surface is at a temperature selected from room temperature to 800 degrees Centigrade, and any temperature in between.

12. The method of claim 1, wherein during depositing the valence-mended semiconductor surface is at a temperature selected from room temperature to 500 degrees Centigrade, and any temperature in between.

13. The method of claim 1, wherein the method significantly improves the capacitance-voltage characteristics of the interface between the dielectric and the valence-mended semiconductor surface.

14. A method of improving the interface between a high-k dielectric and a silicon (100) surface comprising the steps of:

passivating the silicon (100) surface using a Group VI element and hydrogen;

depositing a film of metal on the silicon (100) surface; and

oxidizing the metal film to convert the metal film to a metal oxide film with a dielectric constant larger than 4.

15. The method of claim 14, wherein oxidizing is in an oxygen-containing ambient selected from the group consisting of pure oxygen, an oxygen and hydrogen mixture, water vapor, an oxygen and nitrogen mixture, nitric oxide, nitrous oxide, ozone and combinations thereof.

16. The method of claim 14, wherein depositing and oxidizing do not damage the passivated silicon (100) surface.

17. The method of claim 14, wherein depositing is by evaporation selected from the group consisting of thermal evaporation and electron-beam evaporation.

18. The method of claim 14, wherein oxidizing is from a few seconds to a few hours.

19. The method of claim 14, wherein oxidizing uses a pressure from a few milli-Torr to atmospheric pressure.

20. The method of claim 14, wherein passivating results in a valence-mended silicon surface of one atomic layer thick.

21. A method of improving the interface between a dielectric and a silicon-germanium (100) surface comprising the steps of:

passivating the silicon-germanium (100) surface using a Group VI element and hydrogen;

depositing a film of metal on the silicon-germanium (100) surface; and

oxidizing the metal film to convert the metal film to a metal oxide film which is a dielectric.

22. The method of claim 21, wherein oxidizing is in an oxygen-containing ambient selected from the group consisting of pure oxygen, an oxygen and hydrogen mixture, water vapor, an oxygen and nitrogen mixture, nitric oxide, nitrous oxide, ozone and combinations thereof.

23. The method of claim 21, wherein depositing and oxidizing do not damage the passivated silicon-germanium (100) surface.

24. The method of claim 21, wherein depositing is by evaporation selected from the group consisting of thermal evaporation and electron-beam evaporation.

25. The method of claim 21, wherein oxidizing is from a few seconds to a few hours.

26. The method of claim 21, wherein oxidizing uses a pressure from a few milli-Torr to atmospheric pressure.

27. The method of claim 21, wherein passivating results in a valence-mended silicon-germanium surface of one atomic layer thick.

28. A semiconductor/dielectric interface with improved capacitance-voltage characteristics comprising:

a semiconductor substrate having at least one surface with one atomic layer of valence-mending atoms; and

a metal film deposited on the semiconductor substrate.

29. The semiconductor/dielectric interface of claim 28, wherein the valence-mending atoms were applied upon passivating the semiconductor substrate with an element selected from the group consisting of Group V, VI or VII elements, or hydrogen.

30. The semiconductor/dielectric interface of claim 28, wherein the semiconductor substrate is selected from the group consisting of silicon, germanium, silicon-germanium and silicon-carbide.

31. The semiconductor/dielectric interface of claim 28, wherein the metal film is oxidized to form a metal oxide dielectric film.